MP MASTER

MA24472

# Spectral Dynamics

## Scientific-Atlanta

SERIAL _____

USER'S MANUAL

# 1/1 AND 1/3 OCTAVE OPTION SD345 SPECTRASCOPE III

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

PROPRIETARY RIGHTS OF SPECTRAL DYNAMICS CORPORATION are involved in the subject matter of this material and all manufacturing, reproduction, use and sales rights pertaining to such subject matter are expressly reserved. It is submitted in confidence for a specified purpose, and the recipient, by accepting this material, agrees that this material will not be used, copied or reproduced in whole or in part, nor its contents revealed in any manner, or to any person, except for the purpose delivered.

**Spectral Dynamics**
**Scientific-Atlanta**
P.O. Box 671 • San Diego, CA 92112 • (714) 268-7100 • TWX 910-335-2022

SEPTEMBER 1979©

21188500

## TABLE OF CONTENTS


| Section | | Page |
|---|---|---|
| I | **GENERAL INFORMATION** | |
| 1.1 | Introduction | 1-1 |
| 1.2 | Equipment Description | 1-1 |
| 1.3 | Specifications | 1-1 |
| 1.4 | Replacement Parts | 1-2 |
| II | **INSTALLATION** | |
| 2.1 | Introduction | 2-1 |
| 2.2 | Preparation for Use | 2-1 |
| 2.2.1 | Option Included with Initial Instrument | 2-1 |
| 2.2.2 | Option Field Installation | 2-1 |
| III | **OPERATION** | |
| 3.1 | Introduction | 3-1 |
| 3.2 | Operating Modes | 3-1 |
| 3.2.1 | General Overview | 3-1 |
| 3.2.2 | CRT Annotation | 3-1 |
| 3.2.3 | Graticule Display | 3-1 |
| 3.3 | Front Panel Controls and Indicators | 3-1 |
| 3.3.1 | INPUT Group | 3-1 |
| 3.3.2 | SENSITIVITY Group | 3-3 |
| 3.3.3 | Analysis Group | 3-3 |
| 3.3.4 | TRANSLATOR Group | 3-3 |


## TABLE OF CONTENTS (Continued)


| Section | | Page |
|---|---|---|
| 3.3.5 | CRT Group | 3-3 |
| 3.3.6 | CURSOR Group | 3-3 |
| 3.4 | Operational Checkout | 3-3 |
| 3.4.1 | Lower Band Limits | 3-3 |
| 3.4.2 | 1/3 Octave Upper Limit | 3-4 |
| 3.4.3 | 1/1 Octave Upper Limit | 3-4 |
| 3.4.4 | Input Filter Check | 3-4 |


## LIST OF ILLUSTRATIONS


| Figure | | Page |
|---|---|---|
| 3-1. | 1/3 Octave Spectrum at 2 kHz Range with 500 Hz Square Wave Applied | 3-5 |
| 3-2. | 1/3 Octave Spectrum at 5 kHz Range with 500 Hz Square Wave Applied | 3-6 |
| 3-3. | 1/3 Octave Spectrum at 10 kHz Range with 500 Hz Square Wave Applied | 3-7 |
| 3-4. | 1/3 Octave Spectrum at 20 kHz Range with 500 Hz Square Wave Applied | 3-8 |
| 3-5. | 1/3 Octave Spectrum at 50 kHz Range with 500 Hz Square Wave Applied | 3-9 |
| 3-6. | 1/3 Octave Spectrum at 100 kHz Range with 500 Hz Square Wave Applied | 3-10 |

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_10849

# SECTION I

# GENERAL INFORMATION

## 1.1 INTRODUCTION

This manual contains initial checkout and operating instructions for the 1/1 and 1/3 octave option for the Spectral Dynamics Model SD345 FFT Analyzer. The manual is divided into three sections. Each section covers a specific aspect of the option. This manual is written for the operator and contains no maintenance information. Maintenance information is included in the Service Manual for the SD345 FFT Analyzer.

## 1.2 EQUIPMENT DESCRIPTION

The 1/1 and 1/3 octave option circuitry is contained on PWA 21183100 which is located in card position A5A2 of the SD345 FFT Analyzer. All programming for the option is contained in the Microprogram for the SD345. With the PWA inserted in the A5A2 card position, the Microprogram will respond to the appropriate front panel controls for the 1/1 and 1/3 octave option. No additional equipment is required.

The ACST WTG touch control applies a Type A weighting factor to the input signal. This weighting factor conforms to current American and International standards including ANSI S.1.4, IEC R123, and IEC R179 over the dynamic range of the instrument. The weighting is applied to the input signal and used by the narrow band and octave option input sampling circuitry.

**NOTE**

Type C acoustic weighting can be selected by changing a jumper on the A5A3 card.

## 1.3 SPECIFICATIONS

Operational Characteristics

Center Frequency Ranges (1/3 octave) ..... 100 Hz to 80 kHz (100 kHz range)
50 Hz to 40 kHz (50 kHz range)
25 Hz to 20 kHz (20 kHz range)
12.5 Hz to 10 kHz (10 kHz range)
6.3 Hz to 5 kHz (5 kHz range)
1.6 Hz to 1.25 kHz (2 kHz range)

Center Frequency Ranges (1/1 octave) ..... 125 Hz to 63 kHz (100 kHz range)
63 Hz to 31.5 kHz (50 kHz range)
31.5 Hz to 16 kHz (20 kHz range)
16 Hz to 8 kHz (10 kHz range)
8 Hz to 4 kHz (5 kHz range)
2 Hz to 1 kHz (2 kHz range)

Display Range ..... 30 bands for selected frequency range in 1/3 octave.
10 bands for selected frequency range in 1/1 octave.

Display ..... X-axis: LOG X
Y-axis: LIN or LOG
Overall: Right side of display
Rate: 0.4 seconds

Readout ..... Center Frequency and band number at cursor location.
V, dB, or EU for Y-axis at cursor location.

Averaging ..... LIN or EXPO on non-redundant basis. No. of averages: 2 through 1024. Peak data is stored for each new ensemble.

Filter Characteristics

Attenuation ..... Greater than 60 dB

Passband Flatness ..... ± 1.0 dB

1/3 Oct (except 2 kHz range) new average every 0.4 sec

Passband Uniformity..... Meets ANSI S1.11 – 1966 Class III for 1/3 octave and Class II for 1/1 octave.

Center Frequency ..... In conformance with Paragraph 3.2 Section III ANSI S1.11 – 1966.

Minimum Transmission Loss..... ± 1 dB

Linearity ..... ± 1 dB or ± 0.1% of F.S. whichever is greater.

## 1.4 REPLACEMENT PARTS

Except for some special SDC specification controlled parts listed below, standard electronic parts are used in the 1/1 and 1/3 octave option circuitry. To aid in replacement some miscellaneous parts are also listed. For other parts also used in the SD 345 refer to the parts list in the SD345 User's Manual. Spectral Dynamics maintains a stock of parts used in this option.

When ordering parts, include assembly number of card, reference designation, description, and SDC part number. Also include the instrument serial number and complete model number including "dash" number.

**SD345 1/1 and 1/3 Octave Option Replacement Parts**

| Ref Design | Description | Part No. |
|---|---|---|
| A5A2 | 1/1, 1/3 octave assembly | 21138200 |
| A5A2K1-K7 | Relay RA30381121 | 10610901 |
| A5A2U39 | IC, A/D Converter, Analog Devices part no. AD571KD | 10710700 |
| A5A2U6, 7, 17, 18 | IC (CMOS), Multiplexer, RCA part no. CD4052BF | 10705101 |
| A5A2U9 | IC, Linear Sample and Hold, National part no. LF398H | 10695500 |
| A5A2U58 | IC, PROM (FREQ) | 21176500 |
| A5A2U62 | IC, PROM (OCT 1) | 21176300 |
| A5A2U63 | IC, PROM (OCT 2) | 21176400 |
| A5A2U26 | IC, PROM (INPT 1) | 21150000 |
| A5A2U25 | IC, PROM (INPT 2) | 21150100 |

# SECTION II

# INSTALLATION

## 2.1 INTRODUCTION

This section contains instructions for performing initial inspection of the Model SD345 1/1 and 1/3 octave option. Procedures for inspecting, checking for physical damage, reshipment and returning under warranty or damage claims are in the SD345 User's Manual.

## 2.2 PREPARATION FOR USE

### 2.2.1 Option Included with Initial Instrument

If the octave option is included with the SD345 this subsection does not apply, continue to Section III Operation.

### 2.2.2 Option Field Installation

When the option is to be installed in the field, the following procedure should be followed.

a. Ensure that the SD345 is operating properly.

b. Remove power from the SD345.

c. Unplug the instrument.

d. Remove the top cover.

e. Ensure that all plug-in ICs are firmly seated and that component parts mounted on the option card do not protrude enough to be damaged when the card is placed in the A5A2 slot.

f. Carefully insert the option card in the A5A2 slot (marked A2 on the front channel of the card cage).

g. Make sure that the card is fully seated and the top of the card is even with the other cards.

h. Replace the top cover panel.

i. Plug in the AC power cord.

j. Turn on the SD345.

# SECTION III

# OPERATION

## 3.1 INTRODUCTION

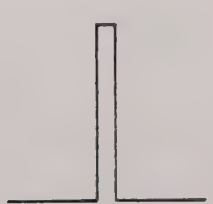
This section provides the operator with a description of the operating modes, the front-panel touch controls and indicators that affect or are affected by the option, and operational checkout.

## 3.2 OPERATING MODES

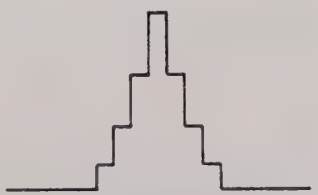
### 3.2.1 General Overview

The octave option provides separate input sampling and A/D conversion circuitry that conditions the input signal to provide the spectrum analysis program with digitized data in the lower frequency bands. In addition to the input signal samples taken by the narrow band circuitry, the octave option samples the input signal for lower frequency components, digitizes the analog data, and stores it in a separate octave input memory. After both memories have been loaded, their contents are transferred to processor memory where a spectrum analysis is performed on each set of data separately. The higher frequency spectrum cells from the narrow band spectrum are used to generate the octave presentation for those bands designated with an "X" in Table 3-1. To increase the resolution in the lower frequencies, the lower frequency cells for the octave presentation are taken from the frequency spectrum generated by the octave input memory data. These lower frequency bands are represented by a "0" in Table 3-1.

Since the octave bands are developed from digital narrow band filters, a given input signal may not produce any power in adjacent cells as with analog octave band filters. As a result, the crt display of a single tonal may not have the familiar conventional shape. A LEAKAGE toggle switch, mounted on the A5A2 PWA, allows the operator to select either the normal SD345 shape or the conventional shape as shown below. The OFF position of this switch selects the normal SD345 shape and the ON position selects the conventional shape. Both of these shapes conform to applicable ANSI standards.



Normal SD345 Shape



Conventional Shape

The 1/1 octave mode of the option provides 10 cells or bands with the center frequency of each cell as listed in Table 3-1 and one additional cell containing the overall spectrum data. In the 1/3 octave mode, 30 cells are provided with center frequencies as listed in the table. Band selection is dependent upon the frequency range set on the front panel touch control.

### 3.2.2 CRT Annotation

The annotation information displayed on the crt periphery is the same as listed in Section 3.7.2 of the SD345 User's Manual with one exception. The cursor information (item 10 in Figure 3-5 of the User's Manual) changes to indicate the band number at the cursor position and the band's center frequency. Band numbers and frequencies will correspond to those listed in Table 3-1 depending upon the selected octave mode.

### 3.2.3 Graticule Display

In the 1/1 and 1/3 octave operating mode the normal crt graticule is modified to provide 10 equally spaced horizontal divisions, each containing either three 1/3 octave bands or one 1/1 octave band. Overall is displayed to the right of spectrum data.

## 3.3 FRONT PANEL CONTROLS AND INDICATORS

Most front-panel controls and indicators function in the same manner as described in the SD345 User's Manual when using the octave option. However, certain switch combinations should not be used because these combinations may produce erroneous display results. These combinations are discussed in the following paragraphs.

### 3.3.1 INPUT Group

#### RANGE (FREQ) Touch Control

Frequency range selection is from 100 kHz to 2 kHz only. The octave option prevents selecting any range below 2 kHz. If a lower range is attempted, the option sets the range to 2 kHz.

All other touch controls in this group operate as described in the SD345 User's Manual.

## Table 3-1. 1/1 and 1/3 Octave Bands and Center Frequencies

| Band No. | Center Frequency | | Selected Front-Panel Frequency Range (kHz) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1/1 | 1/3 Octave | 100 | 50 | 20 | 10 | 5 | 2 |
| 49 | | 80 kHz | X | | | | | |
| 48 | → | 63 kHz | X | | | | | |
| 47 | | 50 kHz | X | | | | | |
| 46 | | 40 kHz | X | X | | | | |
| 45 | → | 31.5 kHz | X | X | | | | |
| 44 | | 25 kHz | X | X | | | | |
| 43 | | 20 kHz | X | X | X | | | |
| 42 | → | 16 kHz | X | X | X | | | |
| 41 | | 12.5 kHz | X | X | X | | | |
| 40 | | 10 kHz | X | X | X | X | | |
| 39 | → | 8 kHz | X | X | X | X | | |
| 38 | | 6.3 kHz | X | X | X | X | | |
| 37 | | 5 kHz | X | X | X | X | X | |
| 36 | → | 4 kHz | X | X | X | X | X | |
| 35 | | 3.1 kHz | X | X | X | X | X | |
| 34 | | 2.5 kHz | 0 | X | X | X | X | |
| 33 | → | 2 kHz | 0 | X | X | X | X | |
| 32 | | 1.6 kHz | 0 | X | X | X | X | |
| 31 | | 1.25 kHz | 0 | 0 | X | X | X | X |
| 30 | → | 1 kHz | 0 | 0 | X | X | X | X |
| 29 | | 800 Hz | 0 | 0 | X | X | X | X |
| 28 | | 630 Hz | 0 | 0 | X | X | X | X |
| 27 | → | 500 Hz | 0 | 0 | 0 | X | X | X |
| 26 | | 400 Hz | 0 | 0 | 0 | X | X | X |
| 25 | | 315 Hz | 0 | 0 | 0 | X | X | X |
| 24 | → | 250 Hz | 0 | 0 | 0 | 0 | X | X |
| 23 | | 200 Hz | 0 | 0 | 0 | 0 | X | X |
| 22 | | 160 Hz | 0 | 0 | 0 | 0 | X | X |
| 21 | → | 125 Hz | 0 | 0 | 0 | 0 | 0 | X |
| 20 | | 100 Hz | 0 | 0 | 0 | 0 | 0 | X |
| 19 | | 80 Hz | | 0 | 0 | 0 | 0 | X |
| 18 | → | 63 Hz | | 0 | 0 | 0 | 0 | X |
| 17 | | 50 Hz | | 0 | 0 | 0 | 0 | 0 |
| 16 | | 40 Hz | | | 0 | 0 | 0 | 0 |
| 15 | → | 31.5 Hz | | | 0 | 0 | 0 | 0 |
| 14 | | 25 Hz | | | 0 | 0 | 0 | 0 |
| 13 | | 20 Hz | | | | 0 | 0 | 0 |
| 12 | → | 16 Hz | | | | 0 | 0 | 0 |
| 11 | | 12.5 Hz | | | | 0 | 0 | 0 |
| 10 | | 10 Hz | | | | | 0 | 0 |
| 9 | → | 8 Hz | | | | | 0 | 0 |
| 8 | | 6.3 Hz | | | | | 0 | 0 |
| 7 | | 5 Hz | | | | | | 0 |
| 6 | → | 4 Hz | | | | | | 0 |
| 5 | | 3.15 Hz | | | | | | 0 |
| 4 | | 2.5 Hz | | | | | | 0 |
| 3 | → | 2.0 Hz | | | | | | 0 |
| 2 | | 1.6 Hz | | | | | | 0 |

### 3.3.2 SENSITIVITY Group

#### dB REF Touch Control

This control operates as described in the SD345 User's Manual with the exception that it should not be used in conjunction with the HMNC cursor mode.

All other touch controls in the group operate as described in the SD345 User's Manual.

### 3.3.3 Analysis Group

#### SPECTRUM

#### 1/1 OCT Touch Control

The 1/1 OCT touch control activates the 1/1 part of the octave option which divides the frequency range selected by the RANGE (FREQ) touch control into 10 bands for analysis. Center frequencies for each band within the range are shown in Table 3-1.

#### 1/3 OCT Touch Control

This control activates the 1/3 part of the octave option which divides the frequency range selected into 30 bands for analysis. Center frequencies for each band within the range is shown in Table 3-1.

When using the octave option, the LIN X touch control is disabled. All other touch controls operate as described in the SD345 User's Manual.

### 3.3.4 TRANSLATOR Group

This group of controls is not used with the octave option.

### 3.3.5 CRT Group

The octave option does not affect the function of the crt controls.

### 3.3.6 CURSOR Group

#### X Touch Control

Only the Hz touch control is used with the octave option. HMNC, orders X, and P touch controls are not used.

#### Y Touch Control

The PSD touch control automatically defaults to the EU display.

#### CURSOR Left/Right Control

The cursor touch controls operate to move the cursor to the right or left one cell location. The cell location or band number will appear in parenthesis in the lower left of the crt annotated display. Band numbers and frequencies are listed in Table 3-1. If no cursor appears on the display, press reset.

The cursor NORM touch control must be set when operating the octave option.

RESET, UPPER, and LOWER touch controls operate as described in the SD345 User's Manual.

## 3.4 OPERATIONAL CHECKOUT

Conditions set up in the following paragraphs check the octave option in the 1/1 and 1/3 mode. Appropriate input frequency ranges are checked using a low-distortion square wave generator. (Model 4000A Krohn-Hite oscillator or equivalent). Cursor positioning and display readouts are checked for the lower and upper band limit in each mode.

### 3.4.1 Lower Band Limits

a. With the octave option PWA installed and power applied to the SD345, press the SPECTRUM 1/1 OCT touch control.

b. With the RANGE (FREQ) touch control, set the frequency range to 100 kHz.

c. Press the CURSOR RESET touch control.

d. Cursor readout in the lower left corner of the crt annotation will read:

(21) × 125 Hz

e. Press the SPECTRUM 1/3 OCT touch control.

f. Cursor annotation will read:

(20) × 100 Hz

g. Sequentially set the frequency to 50, 20, 10, 5 and 2 kHz. With the frequency set and switching from 1/1 to 1/3 OCT the readings below will appear in the cursor crt annotation.

| Freq. Range kHz | 1/3 OCT Band No. | 1/3 OCT Hz | 1/1 OCT Band No. | 1/1 OCT Hz |
|---|---|---|---|---|
| 50 | (17) | 50.0 | (18) | 63.0 |
| 20 | (14) | 25.0 | (15) | 31.5 |
| 10 | (11) | 12.5 | (12) | 16.0 |
| 5 | ( 8) | 6.30 | ( 9) | 8.00 |
| 2 | ( 2) | 1.60 | ( 3) | 2.00 |

### 3.4.2 1/3 Octave Upper Limit

a. With the 2 kHz range and the 1/3 octave mode selected, position the cursor to the right until the cursor crt annotation reads:

(31) × 1250 Hz

b. The cursor will be located at the last cell of the display before the overall signal. This can be checked by advancing the cursor one location and the crt annotation will read:

( ) × 00 Hz

c. With a cursor crt annotation of (31) × 1250 Hz, set the frequency range to 5K.

d. The crt annotation will change to read:

(37) × 5000 Hz

e. Sequentially set the frequency range to those listed below. The cursor crt annotation will be as listed.

| Frequency | Annotation |
|---|---|
| 10K | (40) × 10000 Hz |
| 20K | (43) × 20000 Hz |
| 50K | (46) × 40000 Hz |
| 100K | (49) × 80000 Hz |

### 3.4.3 1/1 Octave Upper Limit

a. With the 100K frequency range and the 1/1 octave mode selected, reset the cursor, then position the cursor for a cursor crt annotation of:

(48) × 63000 Hz

b. The cursor will be located at the last display cell before the overall signal. This can be checked in the same way as step b under 1/3 Octave Upper Limit above.

c. Sequentially set the frequency ranges listed below. The cursor crt annotation will be as listed.

| Frequency | Annotation |
|---|---|
| 50K | (45) × 31500 Hz |
| 20K | (42) × 16000 Hz |
| 10K | (39) × 8000 Hz |
| 5K | (36) × 4000 Hz |
| 2K | (30) × 1000 Hz |

### 3.4.4 Input Filter Check

a. Set up the front panel of the SD345 as follows:

| | |
|---|---|
| FREQ | 2 kHz |
| WTG | ON |
| INPUT LEVEL | 1 Vrms |
| ACST WTG | OFF |
| FUNCTION | SPECT (RT) |
| SPECTRUM | NB |
| GAIN-X | XI |
| GAIN-Y | LOG (no overload) |
| CURSOR | NORM |

b. Apply a square wave signal at 500 Hz, ±5 Hz to the SD345 INPUT Connector.

c. Adjust square wave for full scale amplitude on the crt display and no overload.

d. Position cursor to the 1 kHz position on the crt display.

e. Press the SPECTRUM 1/3 OCT touch control.

f. The resulting crt display will correspond to that shown in Figure 1.

g. Sequentially select frequency ranges 5, 10, 20, 50 and 100 kHz by pressing the FREQ up-arrow touch control.

h. As the frequency range is increased the crt display will change to that shown in the corresponding Figures on the following pages.

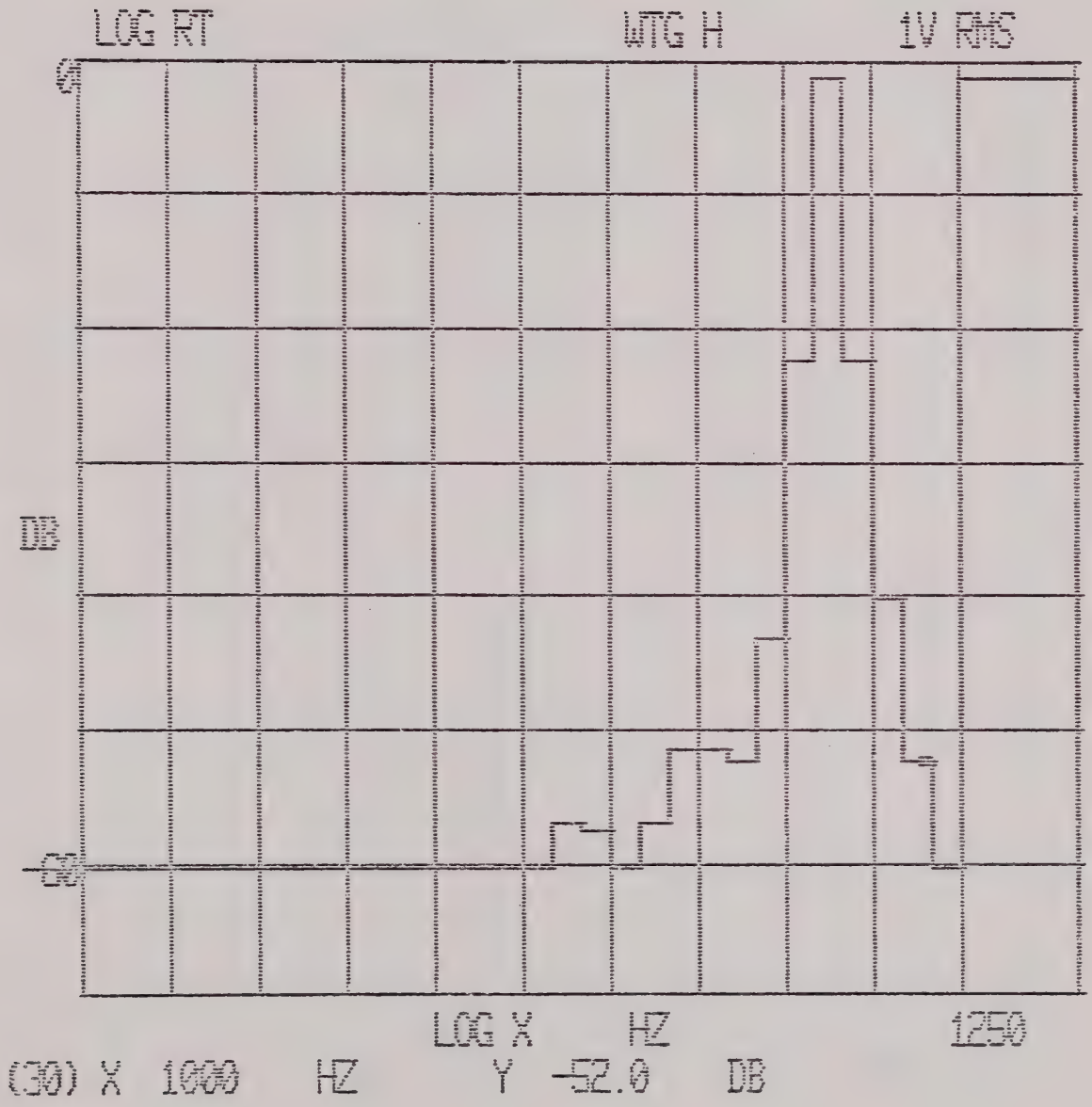



**Figure 3-1. 1/3 Octave Spectrum at 2 kHz Range with 500 Hz Square Wave Applied.**

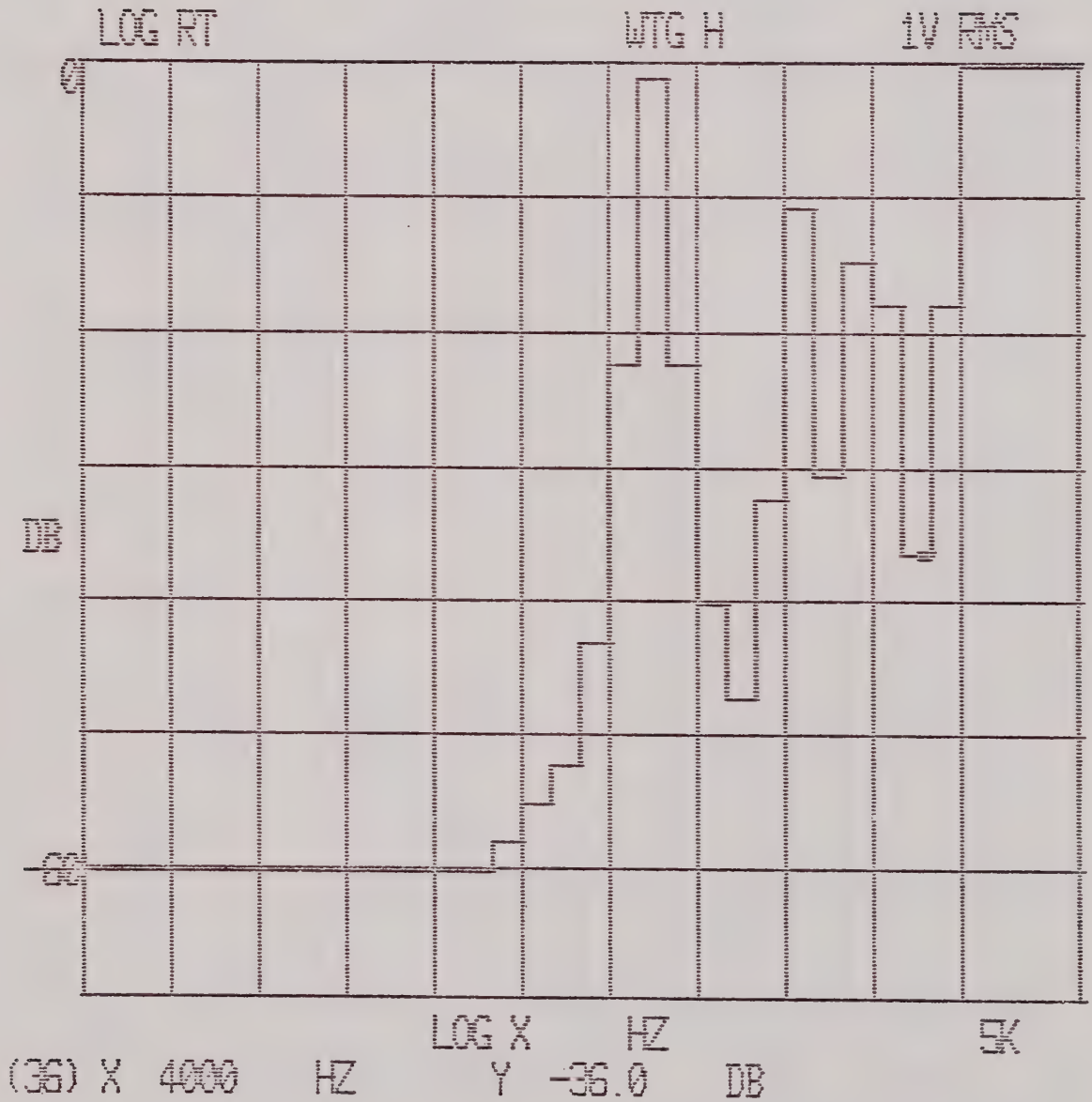



**Figure 3-2. 1/3 Octave Spectrum at 5 kHz Range with 500 Hz Square Wave Applied.**

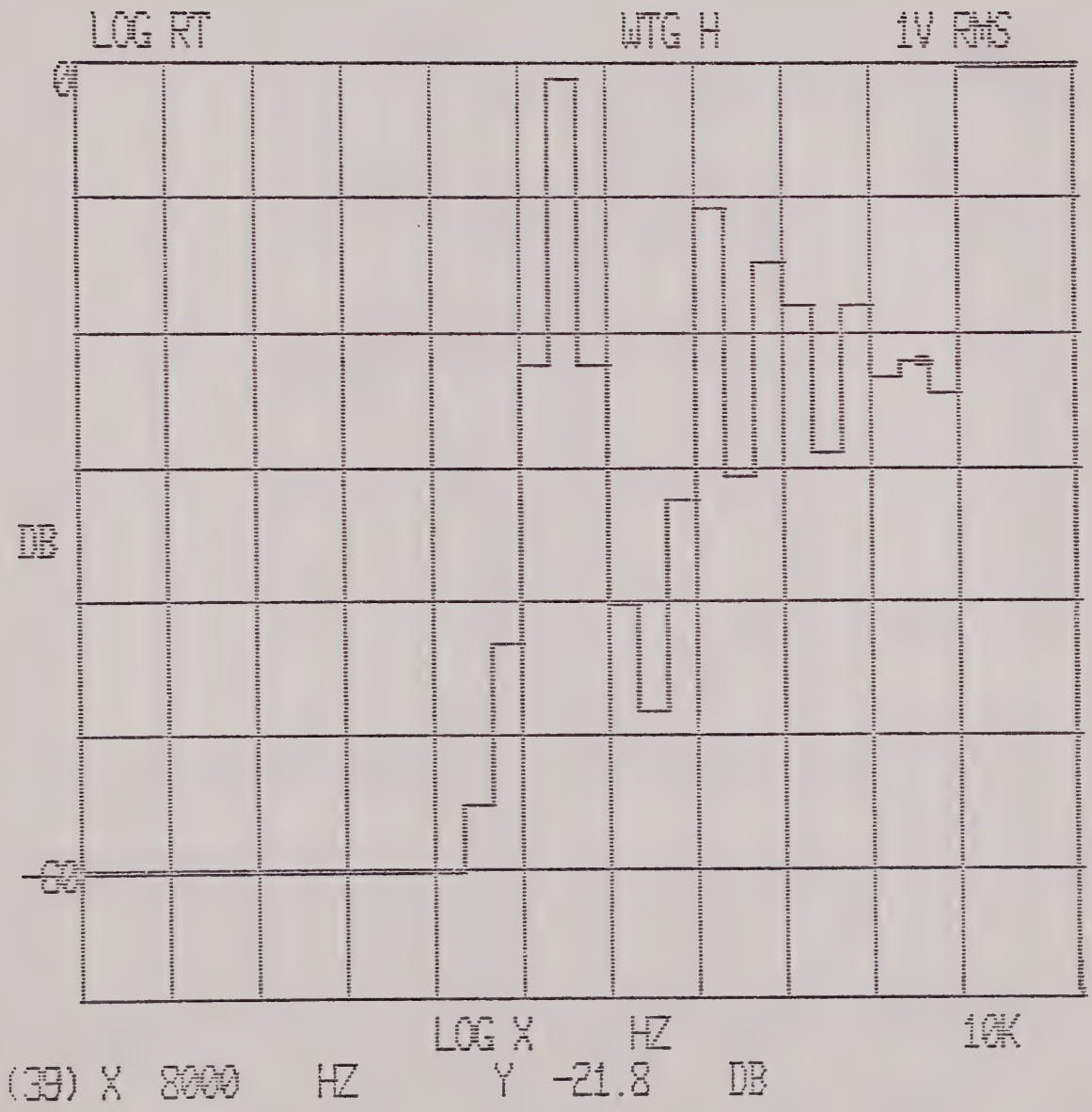



**Figure 3-3. 1/3 Octave Spectrum at 10 kHz Range with 500 Hz Square Wave Applied.**

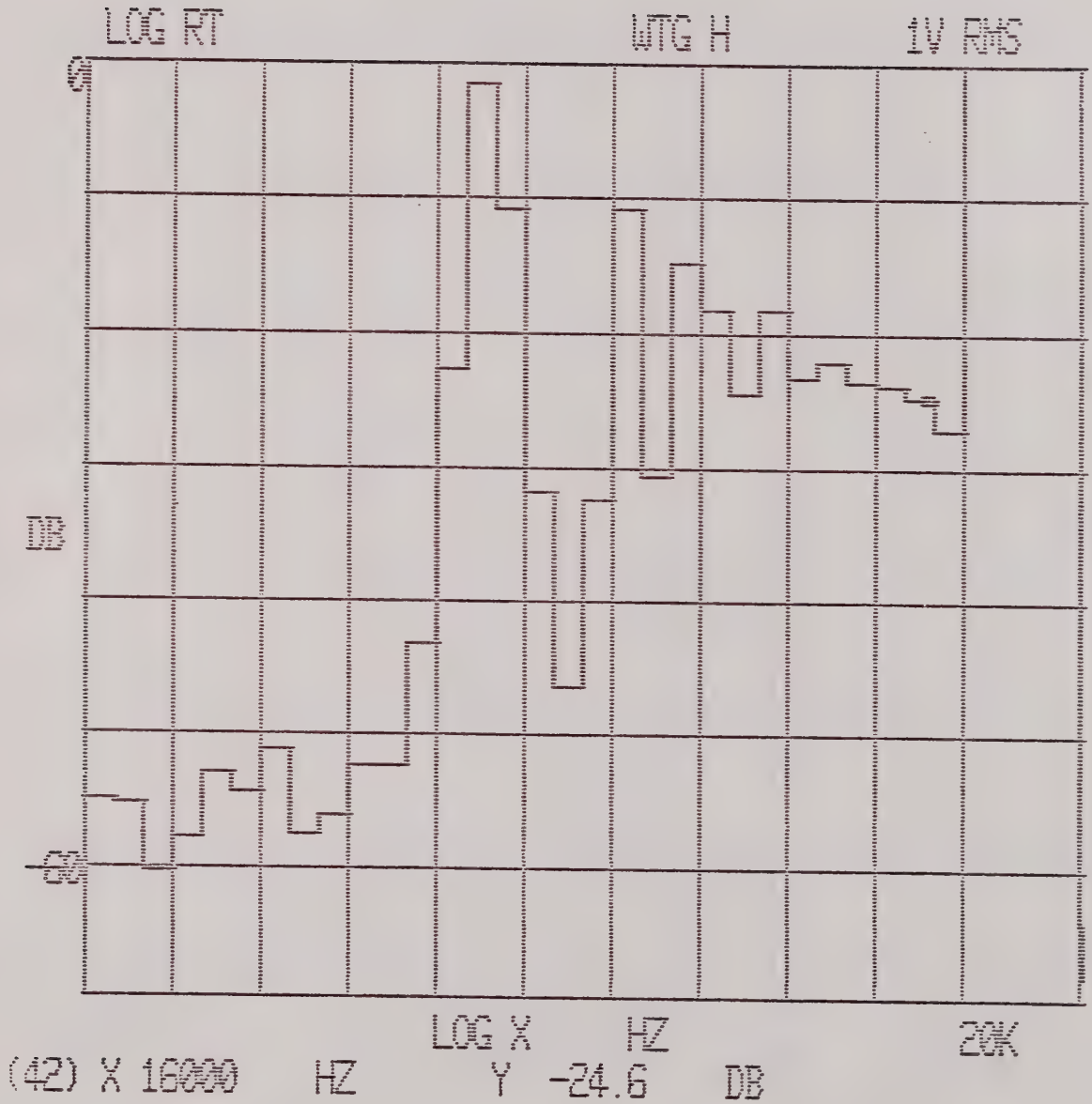



**Figure 3-4. 1/3 Octave Spectrum at 20 kHz Range with 500 Hz Square Wave Applied.**

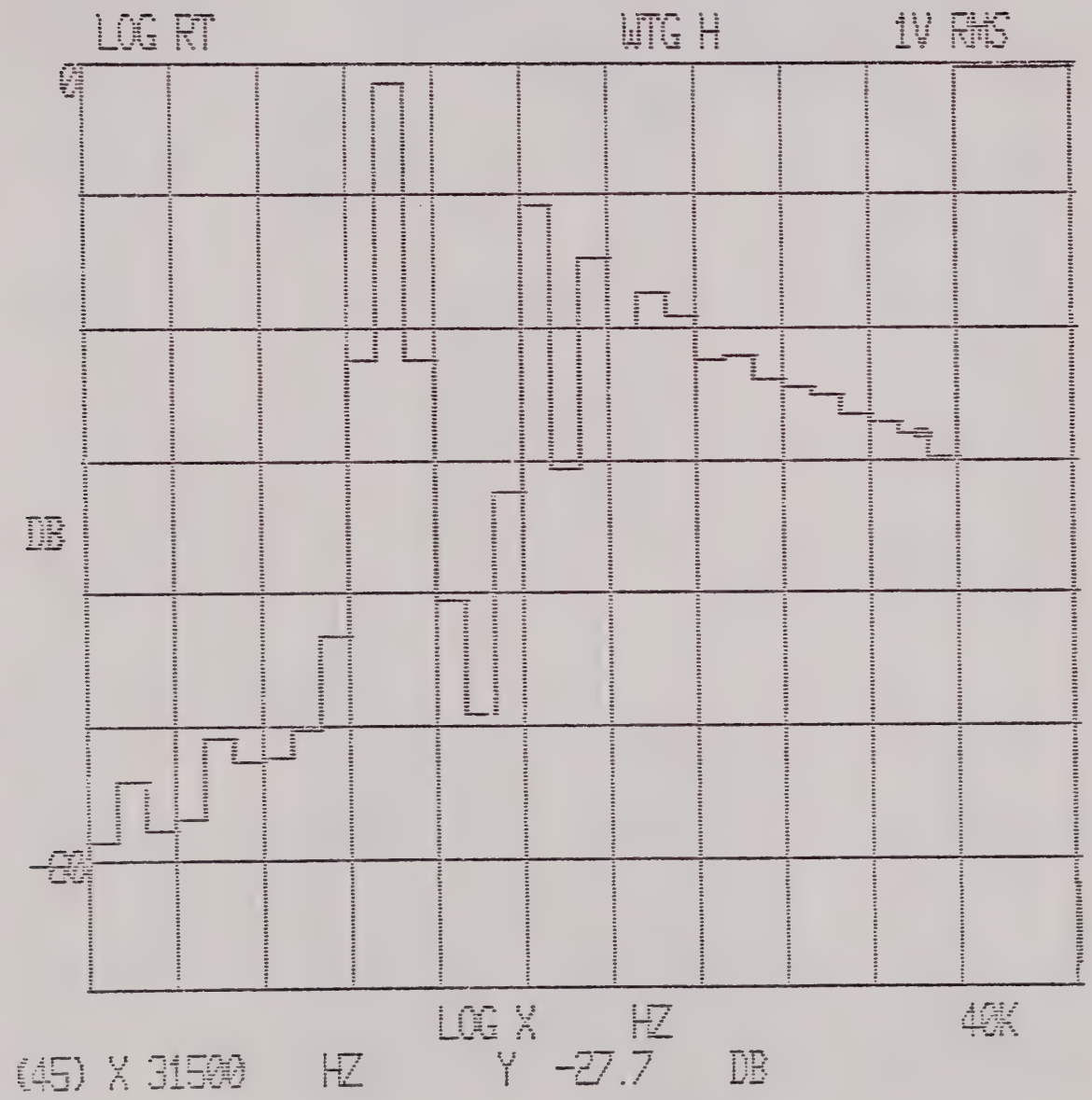



**Figure 3-5. 1/3 Octave Spectrum at 50 kHz Range with 500 Hz Square Wave Applied.**

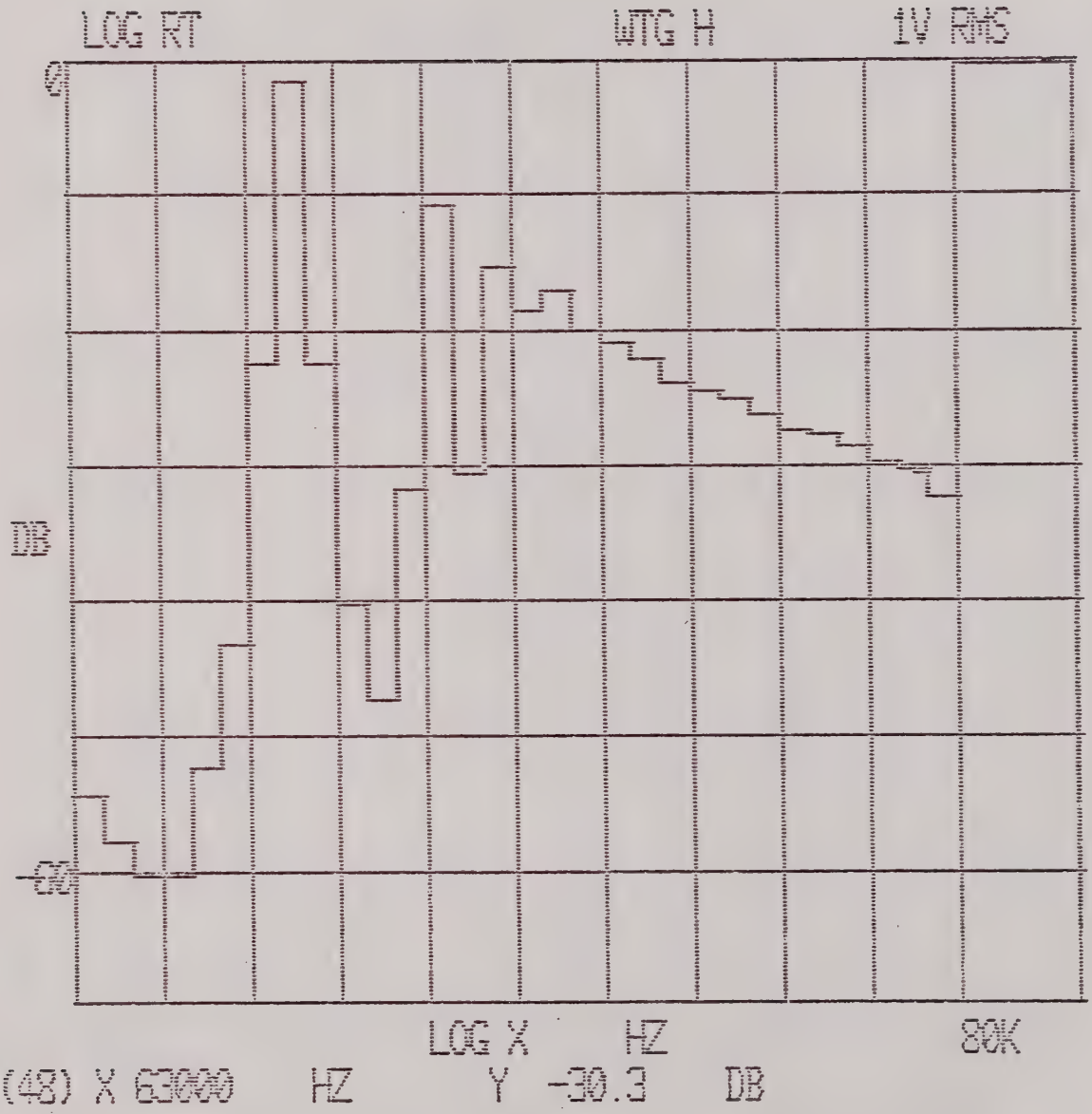
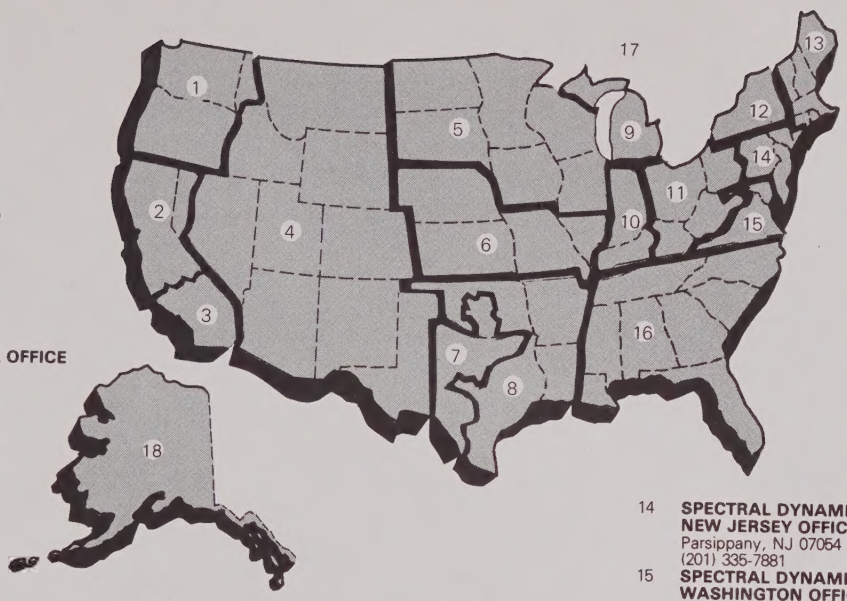



**Figure 3-6. 1/3 Octave Spectrum at 100 kHz Range with 500 Hz Square Wave Applied.**

## NORTH AMERICAN SALES OFFICES AND REPRESENTATIVES




1 **BRETT ASSOCIATES**
Seattle, WA 98116
(206) 935-8054

2 **SPECTRAL DYNAMICS NORTHERN CALIFORNIA OFFICE**
Santa Clara, CA 95051
(408) 733-0602

3 **SPECTRAL DYNAMICS LOS ANGELES OFFICE**
Santa Fe Springs, CA 90670
(213) 949-9421

4 **R.A. MAYES COMPANY**
Albuquerque, NM 87192
(505) 292-2330

Phoenix, AZ 85014
(602) 279-5243

Boulder, CO 80302
(303) 444-0782

Centerville, UT 84014
(801) 292-6781

5 **BERNDT ASSOCIATES**
Chicago, IL 60646
(312) 283-0713

Milwaukee, WI 53227
(414) 545-8400

Minneapolis, MN 55437
(612) 835-4818

6 **ADELPHI, INC.**
St. Louis, MO 63131
(314) 821-1232

7 **CAREY-WOLF & ASSOCIATES, INC.**
Ft. Worth, TX 76116
(817) 461-7333 (METRO)

8 **SPECTRAL DYNAMICS/DYMAC HOUSTON OFFICE**
Houston, TX 77058
(713) 486-1460

9 **SPECTRAL DYNAMICS DETROIT OFFICE**
Southfield, MI 48075
(313) 569-5111

10 **TRI-STATE TECHNICAL SALES**
Indianapolis, IN 46205
(317) 924-3568

11 **SPECTRAL DYNAMICS CLEVELAND OFFICE**
Shaker Heights, OH 44122
(216) 752-7383

12 **D.B. ASSOCIATES, INC.**
DeWitt (Syracuse), NY 13214
(315) 446-0220

13 **NORTHEAST ENGINEERING, INC.**
Hamden, CT 06518
(203) 248-4481

Danvers, MA 01923
(617) 774-3010

14 **SPECTRAL DYNAMICS NEW JERSEY OFFICE**
Parsippany, NJ 07054
(201) 335-7881

15 **SPECTRAL DYNAMICS WASHINGTON OFFICE**
Riverdale, MD 20840
(301) 779-5580

16 **SPECTRAL DYNAMICS ATLANTA OFFICE**
Atlanta, GA 30340
(404) 449-2530

17 **ASSOCIATED TEST EQUIPMENT LTD.**
Scarborough, ON, M1W 2S7
(416) 497-2208

Ottawa, ON, K2A 1C7
(613) 728-3717

Montreal, PQ, H4T 2M8
(514) 481-7733

Vancouver, BC, V6H 1E3
(604) 734-2012

Calgary, AB, T2A 5H7
(403) 230-1697

18 **VECO TURBO SERVICES**
Anchorage, AK 99503
(907) 276-2010

## INTERNATIONAL REPRESENTATIVES

**ARGENTINA**
**ARO S.A.I.C.**
Casilla de Correo 5681
Belgrano 369
Buenos Aires
Telephone: 30-8278
Telex: 17268 ARO AR

**AUSTRALIA**
**Rank Industries Australia Pty. Ltd.**
**Systems Engineering Div.**
19 Trent Street; P.O. Box 127
Burwood, Victoria, 3125
Telephone: 29-3724
Telex: 31809

**BELGIUM & LUXEMBOURG**
**Equipement Electronique**
Chaussee de Vleurgat, 184
1050 Bruxelles
Telephone: (02) 647.06.13
Telex: 22781 EQTRON B

**BRAZIL**
**AROTEC S.A. Industria e Comercio**
Av. Pacaembu 811
01234 Sao Paulo
Telephone: 826 2266
Telex: 1122207 AROT BR

**CHILE**
**Technologia Industrial**
Sanchez Fontecilla 646
Depto. D; Casilla 16037
Santiago 9
Telephone: 481 348
Telex: 260 TIAR

**DENMARK**
**SC Metric A/S**
Skodsborgvej 305
DK-2850 Naerum
Telephone: (02) 80 42 00
Telex: 37163

**ENGLAND**
**Spectral Dynamics—U.K. Branch**
25 Bury Mead Road
Hitchin, Herts SG5 1RT
Telephone: Hitchin 31101
Telex: 826087

**FINLAND**
**Finn Metric OY**
Ahertajantie 6D
Pl. 6, 02101 Tapiola
Telephone: 460-844
Telex: 122018

**FRANCE**
**Spectral Dynamics France, sarl**
129, Avenue Du Marechal Foch
78400 Chatou
Telephone: 698-13-43
Telex: 696385

**GERMANY & AUSTRIA**
**Spectral Dynamics Elektronik GmbH**
Albert-Schweitzer Str. 66/3
P.O. Box 83 27 20
8 Munchen 83, West Germany
Telephone: 89 67 10 44
Telex: 529545

**INDIA**
**Parsram and Co.**
Kailas Darshan, Kennedy Bridge
Nana Chowk, Bombay 400007
Telephone: 357010
Cable: REKAM

**ISRAEL**
**RACOM Electronics Co. Ltd.**
60 Pinkas Street; P.O. Box 21120
Tel-Aviv 61210
Telephone: 453151
Telex: 33-808 RACEL

**ITALY**
**Scientific-Atlanta (Italy) S.p.A.**
Via Benedetto Croce 19
00142 Rome
Telephone: (39) (06) 542-0244
Telex: 612043 MRXROM I
**DYNAMES**
Via P. Bellotti, 2
P.O. Box 82
20017 Rho
Telephone: 9310619
Telex: 311250

**JAPAN**
**Toyo Corporation**
(Toyo Tsusho K.K.)
P.O. Box 5014
Tokyo International
Tokyo 100-31
Telephone: (03) 279-0771
Telex: 02222973

**MEXICO**
**Suxel, S.A.**
Lago Tana No. 70
Mexico 17 D.F.
Telephone: 5-27-59-80

**NETHERLANDS**
**DYMAC-Europe**
P.O. Box 329
Oss
Telephone: 04120-32205
Telex: 50724

**NORWAY**
**Instrument—Teknikk A/S**
Enebakkveien 119
Oslo 6
Telephone: 02-67 15 33
Telex: 19485 INTEK

**SAUDI ARABIA**
**Al-Najim Saudi Int'l. Co. Ltd.**
P.O. Box 1017
Dammam
Telephone: 25427
Telex: 601079 NAJIM SJ

**SOUTH AFRICA**
**Hurbarn Electronics (Pty) Ltd.**
P.O. Box 3236
Johannesburg 2000
Telephone: 37-3954
Telex: 80180

**SPAIN**
**AMESA**
Martinez Campos, 47
Madrid – 10
Telephone: 419-86-87
Telex: 44360

**SWEDEN**
**Martinsson & Co. Instrument AB**
Box 960
S-126 09 Hagersten
Telephone: (08) 744 03 00
Telex: 13077

**SWITZERLAND**
**VibroDyn**
8113 Boppelsen
Zurich
Telephone: BADEN 056/743268
Telex: 53168

**TAIWAN**
**Alpha Precision Instrumentation Corp.**
11th Floor, Express Bldg.
56 Nan King East Road, Sec. 4
Taipei, Taiwan, R.O.C.
Telephone: (02) 7527110
Telex: 25138 APIC

Printed in U.S.A.

MP MASTER
MA24472